

CLAIMS

1. Method for the manufacture of a highly active rubber powder with a specific geometrical surface of 0.4 to 5 m²/g from scrap tyres and vulcanized waste of rubber articles based on different rubber types in an extrusion type apparatus under thermomechanical action, characterized in that the size reduction of vulcanized rubber takes place in two stages:
 - under the conditions of a pulsating volume strain of 15 to 250 MPa increasing at a rate of 5 to 90 MPa/s, with an amplitude ± 5 to 20 MPa and a frequency of 5 to 600 Hz, as well as with a temperature in the range 90 to 380°C increasing at a rate of 50 to 150°C/s accompanied by the simultaneous gas saturation of rubber with degradation products of plasticizing agents and other constituents belonging to the rubber composition, their comminution initially takes place accompanied by the formation of a porous structure in the volume of the particles,
 - in the case of a marked volume strain reduction at a rate of 50 to 150 MPa/s, the porous structure is then destroyed, the specific geometrical surface of the rubber particles is increased and the particles are cooled.
2. Method according to claim 1, characterized in that use is made of waste of rubber articles and scrap tyres based on isoprene, butadiene, styrene butadiene, nitrile butadiene rubbers, including hydrogenated carboxylate, ethylene-propylene, fluorine, fluorosilicone, butadiene vinyl pyridine, silicone, epichlorohydrin, polychloroprene, chlorosulphonated, polyisobutylene and acrylate rubbers, as well as mixtures thereof.
3. Method according to claim 1 or 2, characterized in that for the destruction thereof there is a deformation of vulcanized rubber pieces in the range 105 to 250% of the limit of the elastic component of rubber deformation, accompanied by a simultaneous temperature reduction at a rate of 70 to 150°C/s.
4. Method according to claims 1 to 3, characterized in that for the marked increase of the specific geometrical surface of the rubber powder by 15 to 40% homogeneity modifiers are introduced, namely alcohol telomers of formula $H(CH_2-CF_2)_n-CH_2OH$, where $n > 4$, N-nitrosodiphenylamine, N-cyclohexylthiophthalimide in a quantity of 0.1 to 1.9%, which makes it possible to increase the capacity of the installation by 10 to 55% and the powder storage time up to 6 to 9 months, whilst avoiding caking during transportation.
5. Method according to claims 1 to 4, characterized in that for the manufacture of a highly active rubber from rubber waste, whose composition

lacks constituents degradable at high temperatures, modifiers - alcohol telomers, sulphenamide M, sulphenamide B, stearic, oleic, citric and oxalic acid - are introduced in a quantity of 0.2 to 5.0%, combined with rubbers and form volatile substances at a temperature of 70 to 120°C.

6. Method according to claims 1 to 5, characterized in that for the manufacture of mixed thermoelastoplastics there is a joint size reduction of waste of rubber articles and waste of thermoplastics and/or thermoelastoplastics, namely polyethylenes, polypropylenes, polyvinyl chlorides, polyethylene terephthalates, styrene-butadiene block copolymers, etc.

7. Apparatus for the manufacture of highly active rubber powders from scrap tyres and waste of rubber articles, which has a cylindrical casing (1) provided with a charging connection (2) and a discharging connection (3) and within which are formed a compacting and size reducing zone, which in each case have a compacting worm (6) with a reduction in the depth of the grooves between the combs decreasing in the direction of the size reducing zone and an activator (4) in the form of a rotating body, on whose outer working surface slots are formed, the two elements are mounted in rotary manner coaxial relative to the casing inner surface accompanied by the formation of an annular clearance with the latter, the casing, the compacting worm (6) and the activator (4) being provided with cooling elements (10), characterized in that there are two size reducing zones, the first being formed by a multistart compacting worm (6) with an interturn gap volume decreasing in the direction of the discharge connection (3) and the casing surrounding the same, whose inner surface is formed in the compacting area by a conical opening inclined in the direction of the discharge connection (3) and 3 to 6 ribs with a rectangular cross-section engaging in the interior, where in the first size reducing area the casing inner surface is formed by a cylindrical opening having a diameter which is 1.003 to 1.02 times larger than the diameter of the compacting worm (6) and into the casing inner surface are incorporated with a starting cut pitch 0.5 to 1.5 times the starting cut pitch of the compacting worm (6) helical notches in multistart form with 3 to 50 starts and a constant depth in the straight and/or reverse direction and where the ratio of the extensions of the compacting area and the first size reducing area along the rotation axis of the worm is in the range 1:0.5 or 0.5:1, in addition said compacting and size reducing zones are formed on replaceable, detachable sleeves (9), which are mountable on the shaft or on the casing (1) and have on one side of the sleeve (9) said working surfaces and on the other side the helical grooves with an increased surface of the walls for pumping a cooling element (10), the second size reducing zone being formed by an activator (4) in the form of a rotating body and a discharge worm (5) rigidly connected thereto and fitted in aligned manner with the compacting worm (6), as well as a cylindrical casing surrounding the two

means, whilst in the outer surface of the activator (4) are incorporated with a pitch which is 1.1 to 2.5 times greater than the starting cut pitch of the compacting worm (6) multistart, helical notches with a constant depth in the straight and reverse directions with the same pitch and the same number of starts, on the outer surface of the discharge worm (5) are formed multistart, helical combs in the straight direction with a pitch 1.15 to 3.0 times greater than the starting cut pitch of the compacting worm (6) with an interturn gap increasing in the direction of the discharge connection (3), the combs of the worm being constructed continuously or are interrupted by helical notches in the reverse direction with a pitch equal to the starting cut pitch of the combs, that the cylindrical casing inner surface surrounding the activator (4) and the discharge worm (5) is provided with multistart, helical notches constructed with a pitch 0.5 to 1.5 times smaller than the starting cut pitch of the notches on the activator (4) and the combs of the discharge worm (5) in the straight and reverse directions, the ratio of the extensions of the activator (4) and the discharge worm (5) along the rotation axis being in the range 0.2:1 to 1:0.3, said working surfaces of the activator (4), the discharge worm (5) and the casing on the replaceable sleeves (9) on one side and on the other side are cut helical channels with a larger surface area of the walls for pumping the cooling medium, the multistart, helical notches being constructed with a semicircular profile with a radius which is 0.005 to 0.03 times the worm diameter and a depth which is 5 to 15% smaller than the radius, and the ratio of the number of notches in the straight and reverse directions being in the range 0.3:1.0 to 1.0:0.3.

8. Apparatus according to claim 7, characterized in that the detachable sleeves (9) of the casing (1) and the shaft are constructed in one or more parts.
9. Apparatus according to claim 7 or 8, characterized in that the casing (1) is constructed in the form of one or more parts.
10. Apparatus according to one of the claims 7 to 9, characterized in that the annular clearance between the activator (4) and the discharge worm (5) and the casing inner surface is 1.4 to 2.5 times and the depth of the multistart notches on the casing (1) and activator (4) are 2.0 to 4.5 times larger than the annular clearance between the compacting worm (6) and the casing inner surface.
11. Apparatus according to one of the claims 7 to 10, characterized in that the ratio of the extensions of the first and second size reducing zones along the rotation axis is in the range 0.5 to 1.2.

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12. Apparatus according to one of the claims 1 to 11, characterized in that the working surfaces of the removable sleeves (9) of the casing (1) and the shaft are treated with materials containing tungsten, chromium, nickel, boron, molybdenum, as well as carbides and nitrides of very high melting point metals, in the presence of fluoroorganic substances.

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